

MONTHLY WEATHER REVIEW.

VOL. XIX.

WASHINGTON, D. C., OCTOBER, 1891.

No. 10.

BOARD OF EDITORS { Mr. Horace E. Smith, Chief Clerk Weather Bureau,
Professors Henry A. Hazen, Thomas Russell, and Charles F. Marvin, and
Mr. Edward B. Garriott, in charge of Review Room.

INTRODUCTION.

This REVIEW is based on reports for October, 1891, from 2,541 regular and voluntary observers. These reports are classified as follows: 158 reports from Weather Bureau stations; 118 reports from United States Army post surgeons; 1,640 monthly reports from state weather service and voluntary observers; 32 reports from Canadian stations; 193 reports through the Central Pacific Railway Company; 400 marine reports through the co-operation of the Hydrographic Office, Navy Department; marine reports through the "New York Herald Weather Service;" monthly reports from the local weather services of Alabama, Arizona, Arkansas, California, Colorado, Florida, Georgia, Illinois, Indiana, Iowa Weather and Crop Service, Kansas, Kentucky, Louisiana, Maryland, Michigan, Minnesota, Mississippi, Missouri, Nebraska, Nevada, New England, New Jersey, New Mexico, New York, North Carolina, North Dakota, Ohio, Oregon, Pennsylvania, South Carolina, South Dakota, Tennessee, Texas, Utah, Virginia, Washington, West Virginia, Wisconsin, and Wyoming, and international simultaneous observations. Trustworthy newspaper extracts and special reports have also been used.

CHARACTERISTICS OF THE WEATHER FOR OCTOBER, 1891.

The month was cooler than usual east of the Rocky Mountains and south of the Ohio Valley and the lower lake region, and was warmer than the average October along the Pacific coast, over the Rocky Mountain and plateau regions, and in the middle and upper Missouri and upper Mississippi valleys and the upper lake region. At points in Montana, Oregon, and Washington it was the warmest, and at stations in the south Atlantic and east Gulf states it was the coolest October on record. On the north Pacific coast, and from the lower Missouri valley over the Lake region, New York, south New England, and New Jersey the maximum temperature was the highest, and on the south and east New England coasts the minimum temperature was the lowest ever reported for October.

The line of freezing weather extended over the east Gulf states nearly to the coast line during the third decade of the month, with heavy frost as far south as southern Georgia, central Alabama, and central Louisiana. From the 21st to the 24th light frost was noted in the interior of the Florida Peninsula to about the 28th parallel.

PRECIPITATION.

The monthly precipitation was generally deficient, an excess appearing only along the immediate Atlantic coast north of the 33d parallel, in Kansas and southeast Nebraska, on the northeast slope of the Rocky Mountains, and along the north Pacific coast. At points on the middle Virginia coast, in northeast Kansas, and southern Montana the monthly precipitation was the greatest, and at stations in the east and west Gulf states, the central Ohio valley, the upper lake region, Arkansas, Indian Territory, Texas, western Colorado, northeast Washing-

ton, and southern California it was the least ever noted for October.

Snow fell to the depth of ten to fifteen inches on the northeast slope of the Rocky Mountains and in northwest North Dakota, and the snowfall exceeded five inches in the mountains of Colorado. In the central valleys snow fell as far south as southern Kansas and central Kentucky, and it was reported in the Alleghany Mountains to western North Carolina. The first snow of the season was reported in the Missouri Valley, in Iowa, and over the east part of the middle plateau region during the first decade, in the north part of the upper lake region, in central Kentucky and northern New York during the second decade, and in the Alleghany Mountains, New York, and New England during the third decade of the month.

STORMS.

No well-defined tornadoes were reported. The storms of the north Atlantic Ocean were of exceptional seasonal severity. Heavy gales occurred along the North Carolina, middle Atlantic, and New England coasts. Storms of great energy prevailed in the Lake region on the 26th and 31st, in the Dakotas and Minnesota on the 30th, and on the north Pacific coast on the 18th.

DROUGHT.

Damaging drought prevailed in the southern and southwestern states, and in parts of New England and the Middle and Western States. Rivers and streams in the south-central valleys and the Southern States were very low. On the Tennessee, Red, and Chattahoochee rivers traffic was practically suspended, and navigation on the Ohio and Mississippi rivers was rendered difficult on account of low water.

ATMOSPHERIC PRESSURE (expressed in inches and hundredths).

The distribution of mean atmospheric pressure for October, 1891, as determined from observations taken daily at 8 a. m. and 8 p. m. (75th meridian time), is shown on Chart II by isobars.

In October there is usually an increase in mean pressure over the North American continent, and a decrease in pressure over the north Atlantic Ocean. The normal pressure is highest over the region lying between the 30th and 40th

parallels and the Mississippi River and the Atlantic coast, where it is above 30.10; an area with normal pressure above 30.10 also extends from the Pacific Ocean over Oregon and south Idaho. The normal pressure is lowest north of the 50th parallel and over the extreme southwest part of the country, where it is below 30.00.

In October, 1891, the mean pressure was above 30.15 in an area which extended from the Gulf and south Atlantic states and the Ohio Valley over the middle plateau region, and was lowest over eastern Nova Scotia and the west part of the southern plateau region, where it was below 29.95.

A comparison of the pressure chart for October, 1891, with that of the preceding month shows a general and marked increase in pressure over the interior and western parts of the country, and a decrease along the New England and Nova Scotia coasts and thence over the middle Atlantic states, the upper Ohio valley, and the east half of the Lake region. The greatest increase in mean pressure occurred over the middle plateau region, where it was more than .20, and the most marked decrease along the Nova Scotia and New England coasts, where it exceeded .10.

The mean pressure was above the normal, except along the Atlantic coast, in New England, in Canada east of Manitoba, and along the Pacific coast north of the 40th parallel. The greatest departure above the normal pressure occurred on the west coast of the Gulf of Mexico, and from the east part of the middle plateau region over the middle-eastern slope of the Rocky Mountains, where it was more than .10, and the most marked departure below the normal was noted over eastern Nova Scotia, where it was .10.

A reference to Charts IV and I will show that the area of highest mean pressure occupies the region traversed by a large proportion of the areas of high pressure traced for the month, and that a number of the more energetic low areas advanced from the ocean over Nova Scotia, where, as a consequence, the mean pressure was lower than usual. It will also be observed that the abnormal distribution of pressure for the month had the apparent effect of causing an unusual prevalence of northerly winds over the eastern part of the country, where the month was cooler than usual. It will also be noted that there was a general and marked deficiency in monthly precipitation, except along the immediate Atlantic coast, where heavy rains fell under the influence of the low areas which passed up the coast, in the extreme northwest part of the country near the tracks of low areas from the Pacific Ocean, and along the path of the severe storm which crossed the middle-eastern slope of the Rocky Mountains the first of the month. Throughout the greater part of the region occupied by the area of abnormally high pressure there was a marked deficiency of rainfall.

HIGH AND LOW AREAS.

The paths of well-defined areas of high and low pressure which appeared during the month are plotted on Charts IV and I, respectively, and some of the more prominent features of the areas are shown in the table at the end of this chapter.

HIGH AREAS.

Ten high areas appeared, the average number noted for October during the last 15 years being 7.5. Of the high areas traced 5 appeared on the Pacific coast; 3 advanced from the British Northwest Territory; one was central over New England at the opening of the month; and one first appeared north of the Lake region. Of the Pacific coast areas 3 traversed the continent, one passing off the middle Atlantic coast and thence moving northeastward, one reaching the south Atlantic coast, and one the east part of the Gulf of Mexico. One of the Pacific coast areas moved eastward over the plateau region, thence northward over Montana, and thence southward over the eastern slope of the Rocky Mountains to Indian Territory, where it disappeared, and another moved northward along the middle and north Pacific coasts, and thence eastward to the region north of Montana. Of the areas which advanced from the British Northwest Territory,

one advanced to Nova Scotia, one disappeared over the middle Mississippi valley, and one passed southeastward to the Gulf of Mexico. The high area which occupied New England the first day of the month moved south and west of south and disappeared over the east Gulf states, and the area which first appeared north of the Lake region passed thence south of east to Nova Scotia. The highest pressure reported for the month was 30.76, at Montreal and Quebec, Quebec, the morning of the 12th. The following is a brief description of the high areas referred to:

I.—At the opening of the month this high area occupied New England, a trough of low pressure extended from Manitoba to Arizona, and the pressure was high over the British Northwest Territory. Light frost was reported the morning of the 1st from northern Ohio to Massachusetts, and heavy frost in northern Vermont. Moving slowly southward along the middle Atlantic coast during the 2d high area I passed thence west-southwest and disappeared by a gradual decrease of pressure over the east Gulf states during the 4th, its rate of progress, 16 miles per hour, being the least noted in connection with the high areas of the month.

II.—During the 1st and 2d the pressure was high over the British Northwest Territory, and the morning of the 2d high area II appeared off the Oregon coast, with the lowest temperature of the month at points along the Pacific coast, light frost at Port Angeles, Wash., and heavy frost at Walla Walla, Wash., and Carson City, Nev. During the 2d the high area moved to northern Utah; the lowest temperature of the month was recorded at points in the northern plateau region and on the northeast slope of the Rocky Mountains, where it was 9° to 13° below freezing; the greatest abnormal temperature fall in 12 hours noted for the month, 29°, occurred at Concordia, Kans.; and heavy frost was reported in the middle and northern plateau regions. During the 3d the high area remained nearly stationary over north Utah and southwest Wyoming; cool weather continued over the middle Missouri valley and the Dakotas; the lowest temperature of the month was noted at stations in the west part of the plateau region and on the south Pacific coast; and heavy frost occurred in the plateau region to south Arizona and eastward to the Dakotas. During the 4th the area apparently moved northward over Montana, the temperature was below freezing only in the British Northwest Territory and at points in the middle plateau region, and heavy frost was reported on the eastern slope of the Rocky Mountains, in Kansas, and north New Mexico. During the 5th and 6th the high area moved southward east of the Rocky Mountains and during the 7th disappeared by a decrease of pressure over the southeast slope of the Rocky Mountains. On the 5th the temperature was below freezing on the northeast slope of the Rocky Mountains and in the middle Missouri valley, and light and heavy frosts were noted from the plateau region to the Ohio Valley. On the 6th the lowest temperature of the month occurred in Nebraska and southwest South Dakota, where it was 8° to 10° below freezing, and the first heavy frost of the season was noted at Valentine, Nebr. On the 7th the lowest temperature of the month occurred in east Kansas, Indian Territory, west Arkansas, and north Texas, and heavy frost was observed from Minnesota to north Texas.

III.—Appeared north of the Lake region on the 5th, and moving thence east-southeast disappeared off the Nova Scotia coast the night of the 7th, attended on the 6th by light and heavy frosts in the Lake region and Ohio Valley.

IV.—Was central over Alberta the morning of the 7th, whence it moved southeastward and disappeared over the middle Mississippi valley on the 10th by a decrease in pressure. On the 8th this area, in conjunction with number II, influenced the weather conditions over the Gulf States and Texas. At New Orleans, La., and Brownsville, Tex., the lowest temperature of the month was noted; in the west Gulf states and on the southeast slope of the Rocky Mountains the minimum temperature was 1° to 6° lower than previously re-

ported for the first decade of October; and the first light frost of the season was noted generally in the middle and west Gulf states. On the 9th this area was central over east Kansas, the lowest temperature of the month was noted at Dodge City, Kans., and the first light frost of the season occurred in east Tennessee and west North Carolina. The morning of the 10th a ridge of high pressure extended from the upper Ohio to the Rio Grande valleys; the lowest temperature of the month was noted at Galveston and Corpus Christi, Tex.; the first light frost of the season was reported in central Texas; and the first heavy frost of the season in northeast Texas and central Ohio.

V.—Appeared over the Saskatchewan Valley the evening of the 9th, and pursuing a normal east-southeast course disappeared off the New England coast the night of the 12th. On the 9th the first heavy frost of the season was reported at points in the upper Mississippi valley and at Grand Haven, Mich. On the 10th the temperature was below freezing in Manitoba, and the high area moved north of Lake Superior with pressure 30.70 at White River, Ont. During the 11th the pressure continued very high, with temperature below freezing over the north-central part of the Lake region. On the 12th the high area moved over the middle Saint Lawrence valley and east New England, with pressure above 30.70, and the first heavy frost of the season generally in the lower lake region, the middle and upper Ohio valleys, north Pennsylvania and New York, and at New Haven, Conn., and Eastport, Me. In Chautauqua and Tompkins counties, N. Y., the frost damaged grapes.

VI.—Was central off the Oregon coast on the 10th, moved thence to the Washington coast by the night of the 11th, thence southeastward to Colorado by the 14th, thence to the middle Atlantic coast by the 17th, and disappeared east of Nova Scotia during the 18th, its rate of advance, 26 miles per hour, being the highest noted for the month, and the same as number IX, which also traversed the continent. The morning of the 12th, when this area was central over east Washington, the lowest temperature of the month was reported at Roseburgh and Baker City, Oregon, the minimum at Baker City being 9° below freezing, and the first light frost of the season was noted at Roseburgh. On the 13th the area remained nearly stationary over the middle plateau, with frost in Washington, Colorado, and west South Dakota. On the 14th the center advanced to east Nebraska, the pressure was high from east Montana to the west Gulf coast, the lowest temperature of the month, 24°, was noted at Montrose, Colo., and frost was reported in Montana, Colorado, and Indian and Oklahoma territories. During the 15th the high area moved over the lower Ohio valley, with temperature below 20° in Manitoba and northern North Dakota, the lowest temperature of the month at points in the Missouri and Red River of the North valleys, and the first heavy frost of the season at stations in Missouri and southeast South Dakota. During the 16th the area moved slowly eastward over the upper Ohio valley, the first light frost of the season was reported at points in the east Gulf and south Atlantic states, and the first heavy frost at stations in West Virginia, Kentucky, Tennessee, and at Meridian, Miss. On the 17th the center passed off the New Jersey coast, the pressure was high from the lower Saint Lawrence valley to Florida, the first light frost of the season was reported at points in the east part of the middle and south Atlantic states, and the first heavy frost at Columbia, S. C., Pittsburg, Pa., and at stations in north West Virginia, east Maryland, west New Jersey, and in the interior of Connecticut. During the 18th this high area disappeared south of Newfoundland.

VII.—Appeared off the middle Pacific coast on the 16th, advanced to the lower Missouri valley by the 19th, and passing thence southeastward reached the east Gulf on the 21st. On the 18th, when the high area was central over the middle-eastern slope of the Rocky Mountains, frost was reported in Colorado. The morning of the 19th a ridge of high pressure

extended from Lake Superior to Texas, frost occurred on the southeast slope of the Rocky Mountains, and in the lower Mississippi valley, and the first heavy frost of the season was reported at Vicksburg, Miss. On the 20th the center occupied the middle Gulf coast, the lowest temperature of the month was noted at Shreveport, La., Rio Grande City, Tex., and Pensacola, Fla., the first light frost of the season was reported on the middle Gulf coast, and in south Alabama and south Georgia, and the first heavy frost of the season occurred at points in Louisiana, and at Cairo, Ill., Atlanta, Ga., in the cotton belt of Georgia, and at Raleigh, N. C. On the 21st this high area was central over the middle and east Gulf, the lowest temperature of the month, 59°, occurred at Port Eads, La., the first light frost of the season was noted at points in north Florida and South Carolina, and the first heavy frost of the season at Montgomery, Ala., and Augusta, Ga.

VIII.—Appeared over Alberta the evening of the 19th, and moving thence southeastward reached the east Gulf on the 24th. The morning of the 20th the pressure was high from the British Northwest Territory over the Rocky Mountain and plateau regions and thence to the Gulf of Mexico, and the evening of that date this high area was central over extreme northeast Montana. On the 21st the temperature fell below freezing in the upper Missouri and Red River of the North valleys. During the 22d the high area advanced to the middle Mississippi valley, the lowest temperature of the month was noted along the west shore of Lake Michigan and on the Mississippi River north of the 40th parallel, where it was 1° to 8° below freezing, and heavy frost was general in the middle and upper Mississippi and Missouri valleys. On the 23d the center advanced to the east Gulf states and the pressure was high from the Ohio to the Rio Grande valleys; the temperature was below freezing in east Ontario; the lowest temperature of the month was reported at points from west Michigan to the east Gulf states; the line of freezing weather extended to north Tennessee; and the minimum at Meridian, Miss., was 29°. The first heavy frost of the season was reported at Little Rock, Ark., and at points in central Louisiana, central and north Mississippi, south Georgia, and the Carolinas. During the 24th the center settled southward over the Gulf of Mexico; the lowest temperature of the month occurred in Florida, where the minimum ranged from 44° at Tampa to 67° at Key West; the first light frost of the season was reported in the interior of Florida to about the 28th parallel, and at Savannah, Ga.; and the first heavy frost at stations in the Carolinas. On this date a storm of great energy, low area VIII, was central over the Gulf of Saint Lawrence, the pressure was high north of the Lake region, and the first heavy frost of the season was reported on the Rhode Island coast. On the 25th the pressure was relatively high from the lower lakes to the Gulf of Mexico, the lowest temperature of the month was noted in western New York, where the minimum was 2° to 3° below freezing, and the first heavy frost of the season was reported at Boston, Mass., Harrisburg and Philadelphia, Pa., and Atlantic City, N. J.

IX.—Appeared off the middle Pacific coast on the 23d, passed thence to Utah by the 24th, thence to Manitoba by the 26th, and thence to the North Carolina coast by the 29th, its rate of progress, 26 miles per hour, being the greatest noted for the month, and the same as that of high area VI. The morning of the 25th this area was central over the middle plateau and the evening of that date a ridge of high pressure extended from Alberta over the Rocky Mountain and plateau regions and thence to the Gulf of Mexico. Reports of the 26th indicated that the center had shifted to Manitoba, and the morning of that date the temperature was below freezing in North Dakota and north Minnesota. On the 27th the area was central over the upper Mississippi valley, the minimum temperature fell to or below 32° southward to north Iowa and north Illinois, and the lowest temperature of the month was reported at points in the Red River of the North and middle Missouri valleys. During the 28th the center advanced southeast-

ward over the Ohio Valley, the temperature fell below 32° in east Ontario, the Saint Lawrence Valley, north New York, and north New England, the lowest temperature of the month was reported in Michigan, the middle and upper Ohio valleys, and on the Lake Ontario and south Atlantic coasts, and the first heavy frost of the season occurred at University, Miss., Lynchburgh, Va., and New York, N. Y. During the 29th the center passed off the North Carolina coast, the temperature fell below 32° over the greater part of New England and the Canadian Maritime Provinces, the lowest temperature of the month was noted at stations in the middle and south Atlantic and east Gulf states and New England, the first light frost of the season was reported at stations in north Florida, and the first heavy frost of the season at Wilmington, N. C., Washington, D. C., Baltimore, Md., along the south New England coast, and at other stations in the middle and south Atlantic states.

X.—Was central off the middle California coast the evening of the 28th, advanced northward during the 29th, and reached Alberta on the 30th, whence it moved eastward and at the close of the month was central over Assiniboia. On the 29th when this area was moving northward along the Pacific coast the temperature was below 20° in north Alberta. On the 30th, when the center had advanced to Alberta, the line of freezing weather extended to north Montana, the lowest temperature of the month was noted at Eureka and Sacramento, Cal., and Yuma, Ariz., and the first light frost of the season was reported at Red Bluff, Cal. On the 31st the pressure was high from the British Northwest Territory to the Gulf of Mexico, the temperature fell below 32° from Montana eastward over the north part of the Lake region, the lowest temperature of the month was noted at stations in Montana, east Washington, and east Colorado, and the first heavy frost of the season was reported at Olympia, Wash.

LOW AREAS.

The principal track of October low areas lies along the northern border of the country west of the 100th meridian, whence it crosses the Lake region and Saint Lawrence Valley; a less frequent course is from the middle plateau region to the Great Lakes and thence eastward; and low areas of pronounced strength, averaging about one per year, pass up the middle and south Atlantic coasts.

The paths of 10 low areas are charted for the month, the average number traced for October during the last 15 years being 11. With one exception the paths were confined to the extreme northern and eastern parts of the country, and the tracks converged toward New England and the Canadian Maritime Provinces. Five of the low areas advanced from the north Pacific coast, 4 of which traversed the country and reached the Canadian Maritime Provinces, one low area first appeared over the British Northwest Territory, one apparently developed over the plateau region, one over the Lake region, one in the Ohio Valley, and one on the middle Atlantic coast. From the 12th to 14th the heaviest gales of the month prevailed along the coast from south New England to the Carolinas under the influence of a low area which was central off the coast. The low areas which traversed the western part of the north Atlantic Ocean and the cyclonic areas noted over the West Indies and Gulf of Mexico are given a description under "North Atlantic storms."

The following is a brief description of the low areas which appeared over the United States and Canada:

I.—The month opened with a trough of low pressure extending from Manitoba to Arizona, with two cyclonic centers, one in South Dakota and the other in western Colorado. The evening of the 1st the pressure was lowest over Nebraska. Moving northeast the center of disturbance passed north of Lake Superior during the 2d and thence eastward to the Gulf of Saint Lawrence by the night of the 3d. During the 1st and 2d this low area skirted the west margin of high area I which occupied New England and the middle Atlantic states, and with the southward movement of the high area during the 3d the low

area assumed a normal easterly course. Its advance was attended by a general increase in central pressure, and a warm wave over the central valleys, the Lake region, and the middle Atlantic and New England states.

II.—Apparently developed near the south end of Lake Michigan the evening of the 3d, moved northeastward during the 4th, and passing south of east from Ontario united the evening of the 5th with an ocean storm which had advanced to Nova Scotia from the southward. Attending the development of this low area on the 3d, excessive rainfall was reported in Wisconsin, and the decrease in pressure in 12 hours was .15 to .20 from the south part of Lake Michigan over the Ohio Valley and the south Atlantic states. The greatest energy was indicated the night of the 4–5th, when the pressure fell to 29.60 in east Ontario and west Quebec, and at Rockliffe, Ont., the decrease in pressure in 12 hours was .28 on the 4th. The warm wave noted in connection with low area I extended over the eastern part of the country, and the highest temperature of the month was noted generally in the Atlantic coast states from the 3d to 5th. On the 3d the rain area extended from the Lake region to Kansas, during the 4th it extended eastward to the west slope of the Alleghany Mountains, and on the 5th areas of rainfall appeared in the Atlantic coast states. It will be observed that throughout the course of this low area the attending area of rainfall extended southwestward from the center.

III.—From 8 a. m. to 8 p. m. of the 7th there was a decrease in pressure of .20 to .30 from Lake Ontario to the Virginia coast, and during the night of the 7–8th this low area apparently developed on the middle Atlantic coast, probably in Virginia. The morning of the 8th the storm-center was located off the Massachusetts coast, whence it moved northeastward and disappeared east of Newfoundland during the 9th. The night of the 7–8th excessive rainfall occurred in east Virginia, North Carolina, and the east Gulf states. At Birdnest, Va., 6.85 inches of rain fell in 4 hours. During the 8th heavy rain and hard gales prevailed along the coast from the Carolinas northward. At Sydney, C. B. I., the greatest decrease in pressure in 12 hours noted for the month, .68, occurred from 8 a. m. to 8 p. m. of the 8th.

IV.—Appeared over Alberta the morning of the 10th, and following a normal south of east course reached the Gulf of Saint Lawrence the morning of the 16th, its average rate of advance, 18 miles per hour, being the least noted in connection with the low areas of the month. Rain fell on the north Pacific coast on the 10th. During the 11th the rain area extended eastward to the Dakotas. On this date the storm-center assumed the form of an ellipse, and in the evening extended southward over the Dakotas with a steep barometric gradient to the eastward in the rear of high area V. Wind velocities of 50 to 60 miles per hour were reported in the middle Missouri valley, and a velocity of 66 miles per hour was noted at Huron, S. Dak. During the 12th and early part of the 13th the center remained nearly stationary over Manitoba, its eastward advance being checked by high pressure to the eastward. On these dates the rain area extended eastward to the west part of the Lake region and southward to the Ohio Valley, and high winds prevailed in the middle Missouri valley and over the upper lakes. With the disappearance of high area V off the Nova Scotia coast during the 13th, this low area assumed a more rapid easterly course. During the 14th the rain area extended eastward over the lower lakes and the Ohio Valley, and high winds prevailed over the Lake region. On the 15th the center reached the lower Saint Lawrence valley, and rain fell in areas in the Lake region, the Saint Lawrence Valley, and along the New England and New Jersey coasts. The steep barometric gradient in advance of this low area prior to the 14th had the apparent effect of preventing the eastward extension of the rain area, and it was not until after the gradient had become less marked that rain fell to the eastward of the storm-center.

V.—Was central off the north Pacific coast the morning of

the 14th, moved to the British Northwest Territory, where it remained nearly stationary from the evening of the 14th to the morning of the 16th, thence to the west part of the lower lake region, where it remained nearly stationary from the night of the 18th to the night of the 19th, thence to the Massachusetts coast by the morning of the 20th, where it was joined by an area of low pressure which had advanced north-eastward along the New Jersey coast during the night of the 19-20th, thence to eastern New York by the evening of the 20th, and thence northeastward to the Gulf of Saint Lawrence by the night of the 21st. On the 13th there was a marked rise in temperature on the north Pacific coast, the abnormal rise in 12 hours being 22° at Roseburgh, Oregon. On the 14th rain fell on the Pacific coast north of the 40th parallel and in the valley of the Columbia River, the wind reached a velocity of 61 miles per hour at Fort Canby, Wash., and at night the pressure fell to 29.40 in Alberta. Slight changes occurred in the position and character of this low area during the 15th. The barometric gradient to the eastward, which had been steep on the night of the 14th, became less marked with the eastward movement of high area VI, the main area extended to east Oregon and Washington, and there was an abnormal increase in temperature of 10° to 20° in 12 hours in the middle Missouri valley. From the 16th to 18th the center moved southeastward to Lake Erie. During the 17th an area of general rain extended from the upper lakes to the lower Ohio valley, and wind velocities of 20 to 40 miles per hour were reported over the upper lakes. From the night of the 18th to the night of the 19th the center remained nearly stationary near Lake Erie. On the 18th the rain area extended from Lake Erie southward to Georgia, and a heavy thunder and hail storm was reported in Indiana. The evening of the 19th a cyclonic area appeared over Chesapeake Bay, attended by heavy rain. By the morning of the 20th the two centers had united off the Massachusetts coast, and by the evening of that date the center of disturbance had moved to eastern New York, with unusually severe easterly to southerly gales on the New England coast, and rain from the Ohio Valley over New England. Passing thence northeastward the storm center disappeared over the Gulf of Saint Lawrence the night of the 21st without evidence of diminished energy. Similar to the slow-moving storms previously described for the current month, the rain attending this low area fell to the south and west of the center.

VI.—Appeared over the British Northwest Territory on the 18th, when high west to northwest winds were reported in northwest Washington, and passing thence east-southeast to the Lake region united with low area V on the 20th, its passage being unattended by noteworthy features.

VII.—Appeared on the north Pacific coast the morning of the 22d and moved thence to the British Northwest Territory, where it remained almost stationary until the morning of the 24th, after which it passed east-southeast and disappeared over Nova Scotia the night of the 26th. On the 22d rain fell on the Pacific coast north of San Francisco, Cal., and wind velocity of 55 miles per hour was reported at Fort Canby, Wash., and Winnemucca, Nev. During the 23d and 24th the rain area was confined to Washington and Oregon. On the 23d the highest temperature of the month was noted at stations in South Dakota, Nebraska, and Kansas, and the abnormal rise in temperature in 12 hours was 20° at Huron, S. Dak.

No rain, save light showers in the east part of the Lake region, attended this low area on the 25th. On the 26th rain fell from the Lake region to the New Jersey and New England coasts, heavy gales prevailed over the Lake region, and severe storms were reported in northern Ohio and western New York. The influence of this low area extended over the northeast sections during the 27th, when there was a decrease in pressure of .36 in 12 hours at Sydney, C. B. I., rain fell in areas east of the Lake region and Ohio Valley, and high winds prevailed along the Atlantic coast to the Carolinas.

VIII.—Apparently developed in the Ohio Valley the evening of the 21st, passed thence to the Virginia coast by the morning of the 22d, and moving thence northeastward reached the Gulf of Saint Lawrence the morning of the 24th. During the 21st there was a decrease in pressure of .10 to .20 in 12 hours from Ohio to the east Gulf and South Atlantic coasts, and there was an abnormal rise of 10° to 20° in temperature over that region for the period named. During the 22d the low area increased in energy, the rain area extended over the middle Atlantic states and south New England, and heavy gales reaching a velocity of 50 to over 60 miles per hour prevailed along the Atlantic coast from Nova Scotia to the Carolinas. During the 23d the center of disturbance advanced to the Nova Scotia coast with a marked decrease in pressure, the pressure fall in 12 hours being .66 at Sydney, C. B. I. On this date unusually severe gales prevailed along the New England, middle Atlantic, and North Carolina coasts, a velocity of 64 miles per hour from the north being reported at Block Island, R. I. By the morning of the 24th a further increase in energy was indicated, and the barometer reading at Sydney, C. B. I., 28.72, at 8 a. m., 75th meridian time, was the lowest noted during the month. The influence of this low area, in the form of high winds, was felt over New England until the 25th, but little rain was, however, reported after the 23d.

IX.—Appeared off the north Pacific coast on the 26th and passing thence east-northeast disappeared north of Manitoba during the 27th, its rate of advance, 39 miles per hour, being the greatest noted in connection with the low areas of the month. On the 26th rain fell on the north Pacific coast, the decrease in pressure in 12 hours was .60 in Alberta, and wind velocity exceeding 40 miles per hour was reported on the Washington coast. No rain attended this low area on the 27th; at stations in Montana, Wyoming, and Colorado the temperature was the highest noted for the month.

X.—Appeared on the north Pacific coast on the 28th and passing thence eastward was central over the Saint Lawrence Valley at the close of the month. On the 28th rain fell on the middle and north Pacific coasts and in the valley of the Columbia River, the decrease in pressure in 12 hours was .40 in Alberta, and at points in the middle Missouri valley the maximum temperature was the highest noted for the month. On the 29th the rain area extended to west Montana. On the 30th this low area showed a marked increase in energy, the barometric gradient to the west of the center was steep, the rain area extended to Minnesota, and heavy gales, with snow, were noted in the extreme northwest. On the 31st the rain area extended eastward to New England and southward to Tennessee, and heavy gales prevailed over the Great Lakes, a velocity of 61 miles per hour from the northwest, and an extreme velocity of 120 miles, being reported at Detroit, Mich.

Tabulated statement showing principal characteristics of areas of high and low pressure.

Barometer.	First observed.			Last observed.			Duration.	Velocity per hour.	Maximum pressure change and maximum abnormal temperature change in twelve hours and maximum wind velocity.											
	Date.	Lat. N.	Long. W.	Lat. N.	Long. W.				Station.	Rise.	Date.	Station.	Fall.	Date.	Station.	Direction.	Miles per hour.	Date.		
High areas.																				
I.....	1	44	71	35	85	3-0	16		Sydney, C. B. I.....	Inch. .26	1	Augusta, Ga.....	0	12	Kitty Hawk, N.C.....	ne.	36	1		
II.....	2	44	125	35	98	5-0	22		Pueblo, Colo.....	.32	3	Concordia, Kans.....	29	2	Denver, Colo.....	n.	30	5		
III.....	5	50	86	46	93	2-0	25		Sydney, C. B. I.....	.54	6	Montreal, Quebec.....	13	5	Kitty Hawk, N.C.....	ne.	30	6		
IV.....	7	52	115	39	92	3-0	22		Medicine Hat, N. W. T.....	.30	7	Spokane Falls, Wash.....	17	7	Rapid City, S. Dak.....	nw.	36	7		
V.....	9	53	105	45	68	3-0	25		Portland, Me.....	.40	11	Kingston, Ont.....	18	11	Port Huron, Mich.....	ne.	32	11		
VI.....	11	43	124	44	62	7-0	26		Anticosti Island, G. St. L.....	.40	17	Pueblo, Colo.....	19	12	Eureka, Cal.....	n.	34	11		
VII.....	16	41	125	29	84	5-5	20		Calgary, N. W. T.....	.56	17	Winnemucca, Nev.....	22	15	Rio Grande City, Tex.....	n.	40	18		
VIII.....	19	53	114	29	87	5-0	20		do.....	.42	19	Rapid City, S. Dak.....	20	20	Tatoosh Island, Wash.....	e.	40	20		
IX.....	23	40	125	35	77	5-5	26		Cincinnati, Ohio.....	.46	27	Louisville, Ky.....	23	27	Chicago, Ill.....	ne.	46	27		
X.....	28	37	126	51	105	3-0	24		Saint Vincent, Minn.....	.74	31	Miles City, Mont.....	21	30	Fort Canby, Wash.....	se.	30	30		
Mean.....							4-2	23		.44			19					35		
Low areas.																				
I.....	1	38	108	50	68	2-5	36		Quebec, Quebec.....	Fall. .30	2	Father Point, Quebec.....	Rise. 16	3	Sioux City, Iowa.....	s.	46	2		
II.....	4	44	83	43	66	1-5	25		Rockliffe, Ont.....	.28	4	Yarmouth, N. S.....	13	3	Cairo, Ill.....	nw.	26	4		
III.....	8	42	70	48	54	1-0	38		Sydney, C. B. I.....	.68	8	Sydney, C. B. I.....	18	8	Kitty Hawk, N. C.....	n.	44	8		
IV.....	10	52	116	47	65	6-0	18		Manistee, Mich.....	.34	13	Grand Haven, Mich.....	17	13	Huron, S. Dak.....	se.	66	11		
V.....	14	51	114	49	64	7-0	23		Father Point, Quebec.....	.52	21	Roseburg, Oregon.....	22	13	Fort Canby, Wash.....	s.	61	14		
VI.....	19	53	106	49	88	1-5	33		Medicine Hat, N. W. T.....	.48	13	Valentine, Nebr.....	22	15	Saint Vincent, Minn.....	s.	36	19		
VII.....	22	48	126	45	68	4-5	30		Sydney, C. B. I.....	.36	27	Helena, Mont.....	20	19	Fort Canby, Wash.....	s.	58	22		
VIII.....	22	38	77	47	61	2-0	23		do.....	.66	23	Chattanooga, Tenn.....	24	21	Winnemucca, Nev.....	s.	54	22		
IX.....	26	47	125	53	106	1-0	39		Calgary, N. W. T.....	.60	26	Winnemucca, Nev.....	16	26	Block Island, R. I.....	n.	64	22		
X.....	28	49	125	47	74	3-5	29		do.....	.40	28	Northfield, Vt.....	33	30	do.....	n.	64	23		
Mean.....							3-0	29		.46			20		Fort Canby, Wash.....	s.	46	26		
															Detroit, Mich.....	nw.	61	31		

NORTH ATLANTIC STORMS FOR OCTOBER, 1891 (pressure in inches and millimeters; wind-force by Beaufort scale).

The paths of storms that appeared over the west part of the north Atlantic Ocean during October, 1891, are shown on Chart I. These paths have been determined from observations by shipmasters received through the co-operation of the Hydrographic Office, Navy Department, and the "New York Herald Weather Service."

October usually marks the commencement of the stormy season in the middle latitudes of the north Atlantic Ocean. The north Atlantic area of high pressure contracts, the Iceland area of low pressure extends its limits southward, with a decrease in central pressure, and storms which advance from the west part of the north Atlantic or from the American continent have a comparatively unobstructed path to the middle and north coasts of Europe. Storms of tropical origin are not uncommon in October. West India cyclones of October generally appear over the Caribbean Sea and recurve over or near extreme western Cuba or the east part of the Gulf of Mexico. In the last 18 years 9 storms of marked energy have advanced northward from the Caribbean Sea in October.

The north Atlantic storms of the current month were exceptionally severe, more especially those of the first and second decades of the month. During the first decade a storm of tropical origin advanced from southeast of Bermuda and reached the Newfoundland coast the night of the 5th; cyclonic areas were noted over the east and west parts of the Gulf of Mexico; very heavy gales were encountered over mid-ocean; and unsettled and stormy weather prevailed over the British Isles. In the second decade two energetic storms of tropical origin traversed the western part of the ocean; exceptionally severe weather was encountered over mid-ocean during the first half of the decade; and destructive storms occurred over the British Isles. In the third decade a heavy storm passed along the middle Atlantic and New England coasts and thence over the Canadian Maritime Provinces. Over the middle and eastern parts of the ocean the weather was comparatively settled after the 20th.

On the 1st a storm of considerable energy was central north-east of the Windward Islands, whence it moved northwest-

ward and the morning of the 4th was central west of Bermuda. During the 4th and 5th the path recurved to the north and northeast. The center of disturbance reached Nova Scotia the night of the 5th, and moving thence east-northeast apparently joined the Iceland area of low pressure by the 8th. This storm passed south of Bermuda the night of the 3d-4th, attended by heavy north-northeast to east and south gales, and pressure falling to 28.97 (736) at 8 p. m. of the 3d at Bermuda. Gales of force 10 to 11 attended the recurve of this storm to the northeast, and during the 7th and 8th, when central over mid-ocean, the pressure fell below 29.00 (737), and terrific gales were encountered along the trans-Atlantic steamship routes.

On the 1st a dispatch was received from Havana, Cuba, stating that a slight disturbance was seemingly developing to the southwest. During the next four days a cyclonic disturbance was indicated over the west part of the Gulf of Mexico. On the 6th a cyclonic area was apparently central south of western Cuba; by the 7th this storm had reached southern Florida, moving northeastward. Moving slowly northeastward off the Atlantic coast, the center reached Nova Scotia on the 14th, and moving thence east-northeast, was central south of Iceland on the 18th, and probably passed thence to the British Isles by the 21st. On the 11th, when central off Hatteras, this storm was apparently joined by a cyclonic area from the east part of the Gulf of Mexico. From the 11th to the 14th the passage of this storm was attended by the heaviest gales of the month along the middle Atlantic and New England coasts, and at points from the Carolinas to the southeast New England coast the maximum wind velocity exceeded 70 miles per hour, causing disasters to shipping and damage to property. The very high winds reported are a notable feature of this storm, inasmuch as the barometric depression was slight, the lowest reading being about 29.50 (749) the morning of the 14th. The barometric gradient was, however, very steep to the northward of the center during the 13th and 14th.

On the 5th and 6th the pressure fell below 29.00 (737) in a cyclonic area west of the British Isles, and on the 6th destructive gales prevailed over Ireland and along the west and south